

U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY
WALLS, S13 TO S19

HAER No. HI-84

(U.S. Naval Base, Pearl Harbor, Naval Submarine Base)

(U.S. Naval Base, Pearl Harbor, Sail Docks S13 to S19)

(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)

(Facility Nos. S15/S16, S17/S18, S19, and portion of S10–S14)

Northeast end of Magazine Loch

Pearl Harbor

Honolulu County

Hawaii

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

U.S. Department of the Interior

National Park Service

Oakland, California

HISTORIC AMERICAN ENGINEERING RECORD

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Location: Northeast end of Magazine Loch
Pearl Harbor Naval Base
City and County of Honolulu
Hawaii

USGS 7.5 minute series topographic map, Pearl Harbor, HI, 1998.
Universal Transverse Mercator (UTM) coordinates:
04.609710.2362340
04.609840.2362240
04.609760.2362130
04.609600.2362230

Date of Construction: 1942-1944

Present Owner: United States Navy

Present Occupant: United States Navy

Present Use: Berthing of U.S. Navy vessels

Significance: The piers and quays at the end of Magazine Loch, designated as berths S13 to S19, are significant for their association with the increase in the Pacific submarine fleet during World War II, and as one of the Navy's most important overhaul and maintenance site for submarines. Berths S13 to S19 are contributing facilities to the Pearl Harbor National Historic Landmark, designated in 1964. They are also significant for their association with Cold War submarine operations, as a home port and as a servicing port.

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PART I. DESCRIPTION

Wharfs or Berths S13 to S19 consist of reinforced-concrete quays¹ and piers constructed on composite piles at the northeast (head) end of Magazine Loch in Pearl Harbor. Each "S#" represents an individual berthing space, but some berths are grouped as one facility. For instance, the two piers, which include four berths (one on each side of piers) are considered Facility Nos. S15/S16 and S17/S18. Berths S13–S14 are part of the wharf along the southeast edge of the loch, and that quay wall is listed as one facility or structure (Facility No. S10–S14) in the Navy facilities database, despite its two-phase construction history (see Part II of this report). Berth or Facility No. S19 is the quay along the northwest edge at the end of Magazine Loch and has a separate facility number. The decks of these wharfs are about 8' above the water. At the head of the loch, there are three boat landings whose reinforced-concrete decks are about 4' above the water level.

Measuring across the loch, each of the three boat landings is 165'-0" long and each of the two piers is 26' wide to give a total width of 547'-0" between the outboard edges of the southeast (S13–S14) and northwest (S19) quays. Each quay is 28'-6" wide, so the total width to the outboard edges of the wharf grouping is 604'-0". The quays and piers at the end of Magazine Loch are each 462'-2½" long (see discussion in Part II, Historical Context about the reassignment of berthing space numbers along Facility No. S10–S14).

The quays (Berths S13–S14 and S19) are composed of 43 bents², mostly spaced 11'-0" on center but with 8'-0" on center spacing between the three bents at their *mauka* (northeast) ends (NAVFACPAC 1942, dwg Z-N15-203). The concrete deck of both quays extends beyond the center of the last (southwest) bent by 4'-0" and the beyond center of the first (northeast) bent by 2'-2½". The composite piles supporting the quays are about 1'-6" square with chamfered corners. The type of pile actually used is uncertain because the visible portion of the piles does not exactly match any of the three types shown in a 1941 drawing, including 16"- and 18"-wide concrete bearing piles and a 15" composite bearing pile, but it most closely matches the latter (NAVFACPAC 1941 187159). The composite piles consist of reinforced concrete at the top, which is connected to the cylindrical wood portion below using a steel pipe, 3/8" thick and about 5' long, that wraps around the abutting wood and concrete ends and is secured with lag screws. Only the concrete portion of the piles are visible. Drawings from 1942 and later indicate that 18", not 15", composite piles were used (NAVFACPAC 1942 Z-N15-203). Plans show that next to each inboard pile of the quay bents a batter³ pile with a 4:12 slope was driven, except batter piles are omitted for the three bents at the quays' *mauka* (northeast) ends. Drawings also indicate a 10"-thick reinforced-concrete curtain wall extending down 8'-0" at the inboard edge of the quays (NAVFACPAC 1942, dwg 179956). The reinforced-concrete deck of the quays is a minimum of 11" thick. Quay S13–S14 has a concrete curb, measuring 10" high and 1'-0" wide, at its outboard edge. In lieu of a concrete curb, Quay S19 has a wood curb that is bolted to the deck. This is constructed of timbers approximately 10" square, which are set on spacers approximate 2" high to form scuppers beneath the curb.

The piers (Facility Nos. S15/S16 and S17/S18) are composed of 47 bents, all spaced 10'-0" on center, except for 6'-0" spacing between the pairs of bents at their inboard ends (NAVFACPAC

¹ Quay: a solid masonry landing place built along the edge of a body of water.

² Bent: a framework transverse to the length of a framed structure.

³ Batter: to incline from the vertical. A batter pile is driven at an inclination from the vertical to provide resistance to horizontal forces.

1942, dwg Z-N15-203). The concrete deck of the piers extends 4'-0" from the center of the outboard bent and 2'-2½" beyond the inboard bent's centerline, to give a total length of 462'-2½". The outboard corners of the pier decks are chamfered. Each bent of the piers is composed of six composite piles about 1'-6" square with chamfered corners, topped by support beams or pile caps of reinforced concrete, measuring about 1'-10" wide and 2' high, which are integral with the deck. Adjacent to most bents on both piers are batter piles with a 4:12 slope. These batter piles are inboard of the bents on the Berth S15 and Berth S17 sides and outboard of the bents on the Berth S16 and Berth S18 side, but are omitted in areas with piping outlets. Each batter pile has an angled bracket of reinforced concrete between it and the concrete slab of the deck. The deck thickness of the piers is about 9". The piers have concrete curbs, measuring 10" high and 1'-0" wide, at their edges.

The three boat landings located at the head of the loch each measure 12'-10" in width and 165'-0" in length. They consist of a 1'-0" thick reinforced-concrete deck supported on composite piles. Typically, the bents are composed of pairs of piles, one pile each at the inboard and outboard edges every 10'-0" along the length. Between each pile pair, closer to the inboard plane, is a single battered pile (NAVFACPAC 1942, dwgs Z-N15-202 and 179957). The deck extends beyond the center of the end-pile pairs by 2'-5½" at each end. Concrete stairs with metal pipe railings provide access down about 4' from the piers and quays at each end of the boat landings. Concrete curbs and metal pipe railings are located along the edge of the quay area above the inboard edge of the boat landings.

The surface of the quay area immediately behind the boat landings is made up of a series of concrete slabs, each about 4' x 8' that were pre-cast and placed in position. The slabs are arranged in two rows, oriented with their short sides parallel with the length of the boat landings. These slabs are shown on a historic drawing (NAVFACPAC 1953, dwg 584080) covering a relieving platform which is set on driven piles above the shoreline and carries water and oil lines. At the *mauka* side of these rows of slabs, about 18' inboard from the boat landing, is a bituminous-paved roadway. At the northwest end of the boat landing 1 (between Berths S14 and S15) is a small crane with a single jib that rotates atop a center post.

The fenders in this wharf grouping have been modernized only at Berths S13-S14. Here the fender system consists of rectangular reinforced-concrete piles, which are level with the top of the curb. The spacing blocks, which set the fenders out from the deck edge (approximately 8"), the wales⁴, which separate the fenders, and the paired vertical bumper strips bolted to each fender are formed of a black resilient material. Piers S15/16 and S17/18 and Berth S19 have a wooden fender system at their edges consisting of wood piles driven into the harbor bottom and cut about level with the tops of the curbs. Along the piers, the piles are spaced about 5'-6" on center and are set about 10" from the edge of the deck by bolting them through approximately 10"-square timbers that run along the edge of the concrete deck. Between the piles are timber wales also about 10" square. The piles are less regularly spaced along Berth S19, which has sections with no fenders and then clusters of piles. The boat landings have a wood fender system consisting of approximately 10"-square timbers bolted to the horizontal edge of the concrete deck. There are also two vertical piles in front of the small crane at boat landing 1.

Running parallel to the length of Quay S19 is a section of narrow gauge (3'-0") railroad track that is centered about 6'-0" from the outboard edge of the deck. Two concrete channels, each about 9" wide and 6" deep, are cast into the deck. Each channel carries one rail, whose top is

⁴ Wale: horizontal member, usually timber, which reinforces an upright member.

set approximately level with the deck surface. The channel around each rail is filled with bituminous filler, and the original drawing shows that the top and one side were kept uncovered to allow passage of a steel wheel (NAVFACPC 1942, dwg 179956). Maps from the 1940s show this track was connected to the rail system of the base, but now runs only along the quay to its southwest end. Here the rails terminate at a pair of contoured rail stops, each built of two ½"-thick steel plates that project 1'-9" above the level of the concrete deck and are shaped in a curve to catch the train wheels. The two steel plates are riveted together and secured to metal angles which are bolted into the deck.

At the southwest end of Quay S19 a 45'-0" wide section of wharf is positioned at a right angle to it, extending to the northwest. This section is the beginning of Facility No. S20 (see addendum to HAER No. HI-35), and the end of that wharf's 45' width is in line with the outboard edge of Quay S19. This section of Wharf. S20 extends about 86' to the northwest, before another right-angle turn to the southwest, into the main section of this facility.

The construction details of Berths S13 to S19 are similar to other wharfs at Pearl Harbor, in that they utilize a reinforced-concrete deck that is supported on composite piles driven into the harbor bottom, with batter piles for additional stability. Some larger wharfs (B11 and B12) and piers (B15 to B18) also have reinforced-concrete decks, but they are supported on reinforced-concrete cylindrical columns with flared lower ends. This flared portion rests near or below the harbor bottom on driven reinforced-concrete piles. One other difference noted is that some quay areas in other parts of the harbor utilize sheet piling walls at their inboard sides. Concrete sheet piling was added inland of Berths S13 and S14 in 1952 (NAVFACPC 1952, dwg 551027). Other design changes to Berths S13 to S19 are discussed in the following section.

PART II. HISTORICAL CONTEXT

For more information see Addendum to HAER HI-35, U.S. Naval Base, Pearl Harbor, Floating Drydock Quay and overview report, HAER HI-53, U.S. Naval Base, Pearl Harbor Waterfront Facilities. For more information on the Shop Facilities Compound at Sierra Wharfs see Addendum to HABS HI-293, U.S. Naval Base, Pearl Harbor, Gymnasium Building, Building 667.

The Submarine Base at Pearl Harbor was begun on October 14, 1915 when Admiral George Dewey, who was President of the Navy's General Board, authorized the site at Quarry Point between Magazine and Quarry Loch, as its location. Previously, submarines assigned to Hawaii had operated out of Honolulu Harbor, due to a lack of facilities at Pearl Harbor. Submarine operations were shifted from there to Pearl Harbor in October 1915 when four K-class submarines set up temporary operations at Kuahua Island. After World War I several R-class submarines were assigned to Hawaii and the R-18 became the first to moor at the Quarry Point site of the future Submarine Base in the summer of 1919. Construction of additional facilities at Quarry Point ensued and in February 1920 the site became the center of submarine operations with the closing of the temporary Kuahua facilities (deYarmin 1984, 1-3)

The need for expanding the berthing space for submarines in Magazine Loch was recognized as early as 1940. In the spring of that year the entire Pacific fleet was ordered to be stationed at Pearl Harbor and a memo to the Secretary of the Navy suggested needed improvements for berthing at the Submarine Base (Almay et al. 1940). That year, dredging was undertaken to deepen Magazine Loch in preparation for the new piers and quays (de Yarmin 1984, 3).

Wharfs S13 to S19 were constructed in 1942-1944 at the head of Magazine Loch. The work was accomplished under contracts NOy-3550 and NOy-4173 by Contractors, Pacific Naval Air Bases (CPNAB) a consortium of construction firms responsible for Navy projects (not just air bases) in the Pacific during the build-up to WWII and during its early years, until December 31, 1943 (U.S. Navy 1947, Vol. II, 121). The construction of additional quays and piers at Magazine Loch (Berths S13 to S19) was accomplished under Project Nos. 223 & 223A. This work was finished by Navy Construction Battalion (CB or Seabee) labor after the CPNAB's workers were withdrawn at the end of December 1943. The contractors reported that the degree of completion on these projects was "about ninety-seven percent" (CPNAB n.d., A-622).

The letter S before each of these berths presumably reflects their assignment to or geographic proximity to the Submarine Base. Other letter designations for berths at Pearl Harbor include A, B, F, GD, H, K, M, O, V, and W. Four of those letters also refer to geographical areas (Ford Island, Kuahua, Merry Point, and West Loch). The A and B designations were assigned to berths closest to the harbor entry, Bishop Point and Shipyard, respectively. The carrier wharfs at Pearl City Peninsula were assigned the letter V, perhaps due to the Navy aviation abbreviation of V for heavier-than-air aircraft. Many waterfront facilities in the Pearl Harbor Complex, which are not near the Submarine Base, also have S in front of facility numbers with three or more digits. In those cases, these are not berthing numbers; for instance, all the Ford Island wharfs have berth numbers with F (followed by a number less than 13) as well as three-digit facility numbers starting with S.

The phonetic alphabet is the set of code words assigned to each letter of the English alphabet, so that important letter combinations can be understood by persons receiving radio transmissions. This system came into usage before WWII, and the Army and Navy developed similar, but slightly different sets of code words. In 1941 a Joint Army/Navy (JAN) Phonetic Alphabet was developed, in anticipation of entry into WWII and the need for inter-service communication. The Navy and JAN phonetic alphabets both used "Sail" for the letter S. The need for a common alphabet used by allies, especially the British, during WWII led to a few changes which came into effect on January 1, 1943; these included the substitution of "Sugar" for "Sail" (Alcorn 1999). Apparently this phonetic alphabet for allies was dropped after the war, or not all adhered to it, since historic drawings dating from 1949 to 1953 use the designation "Sail Docks" or "Sail" plus number for the Submarine Base wharfs (NAVFACPAC 1953, dwg 584077 and 584663 and NAVFACPAC 1949, dwg Z-N15-300). In 1957 there was an agreement to use the North American Treaty Organization (NATO) phonetic alphabet. The NATO version changed several call words from those that were used since WWII (or even earlier). Most notably for the major waterfront facilities at Pearl Harbor (among other phonetic alphabet changes), "Baker" was changed to "Bravo," "King" became "Kilo," and "Sail" or "Sugar" was switched to "Sierra." The S wharfs were being referred to as "Sierra" wharfs as early as November 1958 (de Yarmin 1984, 89).

The numbering of the berths in this grouping is a continuation of the numerals assigned to quays and piers at the Submarine Base. Note that before WWII there were few wharfs, so that they could be easily known by name or geographic description; however, pre-WWII pier groupings at the Shipyard and Submarine Base areas were assigned numbers (none of which remain). The waterfront of the south side of Submarine Base was built ca. 1930 and by 1942 was assigned only one berth number, S1, despite its 1000'-plus length. The four piers projecting from the Submarine Base were given Berths S2 through S9 designations (one berth to each side of a pier). The quay along the north waterfront of the Submarine Base (southeast edge of Magazine Loch) was built in 1931 and measured about 1,080' in length. During WWII

U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
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Berths S10 through S13 were designated along it, initially assigning approximately 270' per berth. Because Berth S14 was built later, apparently the entire 462' length of the extension was assigned to that berth. At some date before 1979, the berth sizes were evened out, since a 1979 map for the base shows regularly spaced numbers along that (S10-S13) quay wall and (S14) extension (U.S. Navy 1979). This shifting of berths results in each one measuring about 308', so Berth S13 includes part of the 1931 quay and part of its WWII extension.

On the title block of the original drawings for these wharfs, they were referred to as "additional piers & quay walls" (NAVFACPAC 1942, dwgs Z-N15-200 and subsequent Z-N15 numbers, plus 179955 through 179962). On at least one 1943 drawing, berth numbers for these quays and piers are shown as S14 through S19 (NAVFACPAC 1943 dwg Z-N26-210).

During WWII a group of shop buildings and their support facilities were constructed at the north corner of Magazine Loch, in an L layout roughly parallel to Quay S19 and to the small boat landings between the piers. This group of mostly wooden buildings is referred to as the Shop Facilities Compound, and generally included Facility Nos. 639 through 648. The main buildings were Facility Nos. 644 through 648, respectively housing the foundry, shipfitters shop, machine and electric shop, pattern shop, and the galvanizing and tinning shop. Support buildings included Facility Nos. 639 through 643: latrine, storehouse, salt water and air compressor plant, distilled water plant, and electrical substation, as well as two small temporary buildings (Facility Nos. T8 and T9) a boiler house and office, which were attached to Facility No. 646. Extant buildings in this group include the Dry Dock Storehouse (Fac. 640), the Salt Water and Air Compressor Plant (Fac. 641) and the Foundry (Fac. 644). The buildings in this compound were utilized to support repair work at the Submarine Base and at the base's floating drydock, moored at quay S20, which was built in 1943.

Before 1941, Kuahua (on the northwest side of Magazine Loch) was an island that was accessed by a narrow causeway running approximately along the route of present day North Road between Pierce Street and San Juan Avenue. By October 1941 the area northwest of the causeway was filled. During the following year the filling continued on the southwest side of the causeway, which formed the area inland of Wharfs S14 through S19, occupied by the Submarine Base Shop Facilities Compound at the head of Magazine Loch. While pile driving for the wharfs was underway, the construction crews at work filling the area southwest of the Kuahua causeway ran into problems with the settling of the fill material. The area was described as a "swamp" and it was noted that "an unusual amount of fill was required to bring the area to grade" (CPNAB n.d., A-621). Then one morning the fill was discovered to have sunk about 1'-6", so that "the soft underlying material [was] extruded into the adjacent water," pushing about fifty piles out of vertical by up to 3'-0" (ibid.) The affected piles were pulled and re-driven before filling began again. The problems prompted the re-location of planned shop buildings (Facility Nos. 646, 645, and possibly 644) back further than planned from the head of Magazine Loch. The backfill that was originally intended next to the quay wall here (inboard of the boat landings at the head of the Loch) was also omitted. An electrical duct had been installed near this quay wall to carry power from a substation to the piers (Facility Nos. S15/S16 and S17/S18) and nearby buildings. Subsidence of the fill had also rendered the duct unusable. To resolve the problem a timber deck was built on piles to support a new electrical duct and fuel lines (ibid.). The 1943 drawings for these utility lines are titled "Relieving platform for pipings and electric duct line" (NAVFACPAC 1943, dwgs Z-N15-212 and Z-N15-213).

The expansion of the submarine berthing facilities to cope with the increased demand for overhauls at Magazine Loch was prompted by the number of submarines already based in the

Pacific, and "because of the Navy's decision to assign to that theater a very large proportion of its growing submarine force" (CPNAB n.d., A-619). During the construction process, which also included barracks and support buildings for the staff that would be manning the submarine overhaul complex (Shop Facilities Compound), it was found that the sewage disposal system was not adequate and two new concrete sewer lines were added from the barracks area towards the northwest to empty into Magazine Loch near S13 (CPNAB n.d., A-623).

During the construction of the wharfs and of the Shop Facilities Compound, piles were inadvertently driven through electrical conduits which created a "serious disruption of electrical service" at the area of Magazine Loch. This accident, although determined to have been caused by the contractor's use of unapproved plans, was described as "understandable, in view of the contractor's efforts to complete the work as quickly as possible" (CPNAB n.d., A-623).

Activities at the wharfs during WWII

Between May 1944 and July 1945 the Submarine Base Engineering & Repair department (E&R) overhauled, refitted, or repaired 400 submarines. This was usually accomplished by keeping each submarine at the base for a two-week session during which inspections and necessary repairs were done. E&R technicians would often begin work on the submarines as they were still waiting for berthing space at Wharfs S13 to S19. Officers on board the submarine would provide E&R with work orders, and a repair plan was made while crews from the different shops began disassembly work. Repair work at the Submarine Base peaked in September 1944 when twelve submarines were refitted by the E&R department and twenty-five submarines had voyage repairs, an unusually high number of repairs that had never been achieved in the past (de Yarmin 1984, 40). The term "voyage repairs" encompasses emergency work necessary to enable a submarine to continue its mission, and which can be accomplished without a change in the schedule of a deployment.

A number of submarine tender vessels served the Submarine Base at Pearl Harbor during WWII, repairing the submarines passing through. The USS *Pelias* was berthed at S13 on the morning of the Japanese attack on December 7, 1941 and fired about 200 rounds of 3" antiaircraft shells and 5000 rounds of .50 cal ammunition at the attackers, downing one torpedo plane with the help of fire from the USS *Tautog*. Other submarine tenders at Pearl Harbor during the war were the *Argonne* (also present on the morning of the attack), the *Fulton*, *Sperry*, *Griffin*, *Bushnell*, *Orion*, *Proteus*, and *Eurdale*.

F-4 Submarine near S14

The remains of the submarine USS *F-4* are located under the mud of the bottom of Pearl Harbor in the vicinity of wharf S14. The U.S. Navy's first commissioned submarine to be lost at sea, the USS *F-4* sank with twenty-one men on March 25, 1915 about one mile off Honolulu Harbor in an area that was 305 feet deep. The *F-4* and three other F-class submarines, the *F-1*, *F-2*, and *F-3*, along with their support vessel, the tender USS *Alert*, arrived in Hawaii in August 1914. The *F-4* was constructed in 1909 at the Union Iron Works, San Francisco, California from plans prepared by the Fore River Shipbuilding Company, Quincy, Massachusetts. The four F-class submarines and their tender moored in Honolulu Harbor at Pier 5, the first US submarines to be stationed in Hawaii. Bachelor officers from the submarines were housed on board the *Alert* and the remainder of the crews in barracks nearby, probably at the Naval Station in Honolulu. Meals for the men were served on the *Alert* (de Garmin 1984, 2).

The *F-4* departed on a training voyage the morning of her disappearance, intending to be back at her berth for the noon meal. An oil slick and air bubbles from the sunken *F-4* were observed that afternoon, March 25, 1915, after the vessel was overdue back at her dock. After dragging cables across the ocean floor in the area in attempts to snag and locate the submarine, it was caught late in the morning of the 26th. The 142' long submarine, with a diameter of about 15', displaced 330 tons and could not be moved. Using a combination of hard hat divers, cables, chains and heavy scows with winches, the *F-4* was incrementally raised and moved closer to shore over the next two months. Navy diver Frank W. Crilley was awarded the Medal of Honor in 1929 for his efforts to free a diver tangled at a depth of 250 feet on April 17, 1915. High surf forced a halt to the operation in late May, when the submarine was in about 46 feet of water. On August 29th the *F-4* was lifted off the bottom by using six specially built pontoons that were sunk next to the submarine, fitted with slings, and inflated with air.

The *F-4*, slung under the pontoons, was towed into a floating dry dock in Honolulu harbor on August 31. Only four crew members were identifiable from the remains taken from the submarine. When the *F-4* was in dry dock a hole measuring approximately 8' x 4' was opened in the rear of her hull, using a cutting torch. This allowed entry to the engine compartment, where the remains of a number of the crew were found ("Ten Bodies Found" 1915). The cause of the tragedy was determined to be a leak that allowed seawater to contact the batteries, creating chlorine gas which disabled the crew and possibly caused an explosion. While in dry dock the hull of the *F-4* was "dismantled" ("May Dispose" 1915). It was "stripped of anything of value, or valuable in that it might have some bearing on the disaster's cause" ("*F-4* Stripped" 1915). Apparently this included "the engine and all mechanism" ("Would Put Skeleton" 1915).

After the drydock examinations, the vessel was towed by the tugboat *Navajo*, using the six pontoons, to "an out of the way spot at Pearl Harbor" with a depth of fifteen to twenty feet that was "as nearly beached as possible" with "the pontoons keeping her clear of the harbor floor" ("Rudders" 1915). Apparently the *F-4* was left in this spot, to "rot in the mud bank" presumably near the head of Magazine Loch ("Will Allow *F-4* to Rot" 1915).

The pontoons used in transporting the *F-4* were constructed in the form of large cylinders. They had riveted metal ends, and the sides appear to have been constructed of longitudinal strips of wood held in place by circumferential cables around the cylinders (Naval Historical Center). After being used to transport the *F-4* from Honolulu Harbor to Pearl Harbor they were "moved on skids to dry land, where they [were] left until needed perhaps in the future for salvage of one kind of[sic] another" ("Will Allow *F-4* to Rot" 1915).

An aerial photograph dated November 27, 1923 shows the *F-4* beached, in a position almost parallel to the shoreline, along the east shore of Magazine Loch (see page 25 of this report). It is located about 50' to 100' south of a line drawn through the long axis of Facility No. 416 (NARA 1923, photo #71-CA-157-H-13). The submarine appears to lack its conning tower.

A 1939 map of topography and soundings of Magazine Loch (see page 22 of this report) shows the *F-4* oriented with its axis running northeast-southwest, about 200' from the northeast end of the 1931 quay wall (that end would later be designated Berth S13). The vessel is shown approximately parallel to and only a few feet outboard of the line of the existing quay, and perpendicular to a line drawn through the long axis of Facility No. 417 (NAVFACPAC 1939, dwg B-N22-227). This position appears to be a few hundred feet northeast of the location shown on the 1923 aerial photo. It is possible that the *F-4* was moved this distance northeast to get it

away from the quay, which was constructed ca. 1930. If left in the 1923 position the submarine would have interfered with construction and berthing at the north end of that quay.

In 1940 it was observed that the *F-4* lay adjacent to the path of the planned expansion of the S wharfs along Magazine Loch (that is Berth S14). A trench was dug next to the *F-4* and it was rolled in (Searle and Curtis 2006), apparently to allow sufficient water depth for vessels using S14. In October 1958, an attempt seems to have been made to raise the submarine. It was reported that divers from the USS *Greenlet*, a submarine rescue vessel stationed at Pearl Harbor, were using "high pressure hoses to ...wash away the mud" from the buried submarine ("The Sea Gives Up" 1958). It was also reported that the vessel was estimated to be raised in six months time, but there is no indication that the *Greenlet* ever completed this task (Lauzon 2008). In 1990, on the 75th anniversary of the sinking of the *F-4*, there was another revival of interest in raising the hull (Mayer 1990)

In October 1998 a survey of the harbor bottom adjacent to Berths S13 and S14 was conducted by divers using a metal detector and probing rod. This turned up no evidence of the submarine buried there. During that survey, persons with good knowledge of Pearl Harbor, (a dock master and a harbor pilot) stated that they believed the *F-4* was located shoreward of the bulkhead of the quay (Rocheleau 1998). If this were the case, then the trench that was dug in 1940 was inboard of the *F-4* and it was rolled toward shore into it. This would seem to be a good decision on the part of the builders of the additional quays, to put the large hull of the *F-4*, a potential obstruction to future ship operations or dredging projects, out the area where it would interfere with the operation of the quay. However, to roll it entirely out of the way of the pile driving for the additional quay, it would have to have been rolled more than 30' to reach the area of fill behind the Berth S14 quay bulkhead.

Another survey of the submerged area of S13-S14 was conducted the following year using a towed magnetometer. This survey detected the presence of a massive object "on the order of tons, at least" and possibly buried by 20 or more feet of sediment, in a position perpendicular to and about 80' from station 1360 on S14 (Barry 1999). This position corresponds closely to an area outboard of the *F-4* site indicated on the 1939 Soundings map of Magazine Loch, suggesting that the 1940 trench was dug outboard of the vessel and it was rolled deeper into the harbor and buried under the bottom, rather than moved ashore of the quay bulkhead.

Submarine Base During the Cold War

The submarine base at Pearl Harbor has been host and home port to many notable submarines during the 1950s and early 1960s, and Wharfs S13 to S19 have been the site of some historic events. On May 13, 1957 the submarine SSG-282, USS *Tunny*, arrived at the submarine base to begin a tour of deterrent patrols and exercises, using Pearl Harbor as her home port. The *Tunny*, a diesel-electric boat of WWII vintage, was (along with the USS *Barbero*) one of the first submarines to be fitted to fire a guided missile that was equipped with a nuclear warhead. These Regulus missiles were transported in a metal locker added to the deck of the submarine and were removed for firing and launched from the deck.

On February 21, 1958 the USS *Gudgeon* (SS-567) berthed at S14 after becoming the first submarine to circumnavigate the globe (Krauss 1958). The *Gudgeon*, a diesel-electric boat built in 1952 and home-ported at Pearl Harbor, had sailed on July 8, 1957 to begin its historic cruise, participating in exercises at Yokosuka Japan in August before completing its 25,000-mile, eight-month voyage.

The USS *Nautilus* (SSN-571) the world's first nuclear-powered submarine, launched in 1954, arrived at the submarine base on June 28, 1958 ostensibly "to introduce the Navy's nuclear propulsion program to Hawaii" as reported in a Honolulu newspaper (Bendix 1958). In reality the submarine made landfall at Pearl Harbor's submarine base to await more favorable ice conditions after making an unsuccessful second attempt to cross under the arctic ice pack. The *Nautilus'* first attempt at crossing the Arctic ice cap, in September 1957, ended when it damaged two periscopes on the underside of the ice. In April 1958 the submarine departed the east coast and transited the Panama Canal to the Pacific where it would make its second attempt to sail under the North Pole. Soon after leaving Groton Connecticut on the beginning of this voyage, a saltwater leak developed in one of *Nautilus'* steam condensers. The submarine stopped at Mare Island Naval Shipyard, San Francisco for repairs, but the leak could not be located. Also during this stopover, damage was repaired from a fire aboard the ship that occurred on May 4, 1958 just after leaving the Panama Canal. This fire broke out in oil-soaked insulation around a turbine and caused minor injuries before it was extinguished. The submarine had to surface to ventilate after this fire (Doehring 2006). After leaving Mare Island, the submarine proceeded to Seattle where the ships commander, William Anderson, directed sailors to change into civilian clothing and scour the automotive shops of the city to purchase cans of Bar's Leak, a product designed to stop leaks in car radiators. The men returned with 140 quarts of the product. Half of this was poured into the condenser, and the leak was stopped. Early on June 9, 1958 the *Nautilus* left Seattle and headed north to transit the pole. When running on the surface of Puget Sound on the way out to sea, Anderson had the crew paint out the submarine's identifying numbers on the bow and conning tower "to conceal the sub's identity" (Wilma 2003). The *Nautilus'* departure from Seattle was under orders to conduct the top secret "Operation Sunshine," the first transit of the north pole by a ship (Nichols 2007). In the shallow Chuckchi Sea the *Nautilus* encountered thick sea ice which forced her to abort this second attempt and she sailed south to Pearl Harbor, arriving on June 28 for a stay that would extend to almost a month while the ice thinned.

On July 22 at about 8:00 pm local time the *Nautilus* pulled away from Berth S18 at the submarine base to begin her historic cruise under the arctic ice cap, the third attempt to do so. Just as for its arrival at Pearl Harbor, a cover story was utilized for the *Nautilus'* departure. President Eisenhower had just sent U.S. Marines to Lebanon to support the pro-western government there and the popular assumption was that the *Nautilus* was headed back to the east coast in anticipation of a possible Lebanese deployment (McNally 2008). Because of the situation in Lebanon, the military of both the United States and the Soviet Union were on alert. This meant that the *Nautilus*, traveling through the Bering Strait on its secret mission to cross the pole, could possibly be attacked by either nation if detected (McNally 2008). The *Nautilus* ran submerged from Oahu to the north coast of Alaska, surfacing there to get a fix on her position (Voyage 1958). The *Nautilus* searched for deep water off Point Barrow, finding the Barrow Sea Valley. She submerged in the northern Chukchi Sea on the 1st of August and passed under the North Pole on the 3rd at about 11:15 pm EDT before surfacing northeast of Greenland. *Nautilus* became the first vessel to reach the geographic North Pole. For fear of disturbing the inertial guidance system of the *Nautilus*, the submarine did not surface at the North Pole during this historic crossing of the ice pack. The first submarine to surface at the North Pole was the USS *Skate* (SSN 578) on March 17, 1959.

Perhaps even more important to Hawaii and the Pearl Harbor Submarine Base was the stationing of the fifth nuclear submarine in the United States' fleet, the USS *Sargo* (SSN-583) at the Submarine Base. The *Sargo* first arrived here on October 14, 1958 on a training cruise

shortly after it was commissioned. The vessel made another visit early in 1959 before its home port was officially changed from San Diego to Pearl Harbor on July 26, 1959. The submarine arrived again at Pearl Harbor on October 1, 1959. The *Sargo* completed a cruise through the Arctic Ocean, running under the ice for over 6,000 miles and becoming the first submarine to surface at the North Pole during the winter season, on February 9, 1960, and receiving a Navy Unit Commendation Award for the most extensive under-ice exploration to date. *Sargo* had been back at Pearl Harbor for a little over three months when, on June 15, 1960 a fire erupted in her aft spaces from a high-pressure oxygen leak when she was taking on liquid oxygen at Berth B of Wharf S1 at the Submarine Base. The ensuing fire resulted in a low-order detonation of two Mk 37 torpedo warheads in the aft torpedo room. Machinist's Mate Third Class James Smallwood, who was tending the oxygen line was killed in the explosion and posthumously awarded the Navy and Marine Corps Medal for his actions in isolating the compartment which contained the leak, probably saving the *Sargo*. After the explosion the fire was not brought under control and the *Sargo's* officers cast off from the wharf and submerged with the aft hatch open to extinguish the fire. *Sargo* was subsequently raised by a floating crane and drydocked for three months for repairs. Between July 1962 and March 1963 the *Sargo's* nuclear reactors were refueled at the Pearl Harbor Naval Shipyard, the first nuclear-powered submarine to undergo refueling at the facility. The *Sargo* was operating in the Western Pacific at the time of the Gulf of Tonkin Incident on August 4, 1964 and she participated in support operations during those early days of the Vietnam War before returning to Pearl Harbor in October. The *Sargo* collided with the USS *Barb* (SSN-596) on October 13, 1965 in Hawaiian waters, receiving damage to her forward deck and sail. During 1970 the *Sargo* spent 10 days in the floating dry dock ARD-30 to receive a patch on the hull at the No. 2 aft trim tank. The ARD-30 was berthed at S20 during the early 1970s.

Another operational barrier for submarines was conquered in August 1960 when the USS *Seadragon* (SSN-584) transited from the Atlantic to the Pacific Ocean via the Northwest Passage. The submarine, home ported at Pearl Harbor, arrived at the Submarine Base on September 15, 1960. The *Seadragon* also supported operations in Vietnam just after the Gulf of Tonkin incident, sailing on August 10, 1964.

The limitations of the subsonic Regulus missile that was utilized on the USS *Tunny* encouraged the development of its successor, the mach 2 Regulus II guided missile. The first firing of this missile from a submarine, the diesel-electric USS *Grayback* (SSG- 574) occurred on September 16, 1958. In November of that year the *Grayback* sailed into the Submarine Base, its new home port ("Colorful Welcome" 1959). The Navy's interest in the Regulus II missile was short. In late 1959 the Polaris ballistic missile program was seen as the future of submarine-launched missiles and the Regulus II program was cancelled in December. This decision was prompted by huge advances in the Polaris program, a missile that could be fired from a submarine while it was submerged. The Regulus II was developed only as a stopgap measure in case of unsuccessful efforts in the Polaris missile program. With the favorable Polaris testing, it was understood that it would be wasteful to sink any more dollars into an obsolete (although workable) Regulus II program. Although the Polaris became operational from the USS *George Washington* (SSBN-598) in November 1960, the *Grayback*, and its sister ship, the USS *Growler* (SSG-577) along with the USS *Halibut* (SSGN-587) patrolled from Pearl Harbor with Regulus missiles until 1964. During that time, Berths S10 to S14 were the sites where Regulus missiles were loaded and unloaded from the diesel-electric submarines, the *Grayback* and the *Growler*. This was accomplished using a mobile crane with an 80' boom which had a greater reach than the 28' required to remove the missiles from the deck hangar of these submarines (NAVFAC PAC 1960, dwg 9293 – see page 31 of this report). Also during the early 1960s,

Facility No. S10-S14 and the same mobile crane equipment were used to berth and service nuclear submarines of the Ethan Allen class (NAVFACPAC 1960, dwg 9293). These submarines patrolled with Polaris missiles equipped with nuclear warheads.

Alterations and Dredging at the Wharfs

Numerous alterations to the wharfs have occurred since WWII, including several in the decade or so following the war. In 1948 twelve electrical power outlets on wharfs S14 to S19 (two outlets for each berth) were rebuilt (NAVFACPAC 1948, dwg Z-N15-341). Repairs to the concrete beams at Berth S13 were undertaken in 1950 (NAVFACPAC 1950, dwg Z-N15-311). In 1952 new concrete sheet piling was added at the inboard edge of Berths S13 and S14 (NAVFACPAC 1952, dwg 547708). Alterations to the wharfs in 1953 included two new buildings. One was Facility No. 796, a building for ships storage, constructed near the end of Pier S15/S16. The other was Facility No. 797, used for deep sea dive training, and built on the boat landing between Berths S14 and S15. Also in 1953, work was performed in the area inland of the three boat landings, with some improvements to the Wharfs S14 to S19. This consisted of new relieving platform slabs set on concrete piles, concrete retaining walls, concrete drains, a new electrical duct line, and new asphalt paving (NAVFACPAC 1953, dwgs 584076 thru 584091). In 1956, the electrical outlets were further improved at Berths S13 to S19 (NAVFACPAC 1956, dwg 751292).

In 1967 new piping for diesel and lubricating oil was run under the wharfs (NAVFACPAC 1967, dwgs 1221745 to 1221747). The concrete curb at the edge of berths S13 and S14 replaced the wood curb in 1977 (NAVFACPAC 1977, dwg 7018884). In 1982, repairs were carried out on the freshwater system that services the Submarine Base wharfs, including Berths S13 to S19 (NAVFACPAC 1982, dwgs 7047780 to 7047798). For these repairs, some pipe hangars and portions of the piping for the two freshwater lines (6" line and 2½" line) were replaced.

Dredging at the wharfs has also occurred since their construction. A series of 1959 drawings (NAVFACPAC 1959, dwgs 841782 & 841784) shows planned dredging to increase the depth at the outer berths (S14, S15, S18, and S19) to 35' and the depth between the two piers (Berths S16 and S17) to 30'. This increase is from typical (1959) depths of about 20' to 24', with shallower areas closer to the boat landings and at the edges of the quays and piers. A later drawing which shows the soundings in these areas in February 1965 (NAVFACPAC 1965, dwg 1069476) has depths which indicate that this planned dredging was only partially carried out. The 1965 depths at Berths S14 and S15 show a depth increase that is typically 8' to 10' greater than the 1959 soundings. Other harbor areas at the head of Magazine Loch around the wharfs show depths very close to the 1959 soundings, typically a foot or so shallower. This slight decrease in depth is to be expected from shoaling action within the harbor. Also indicated on the 1959 drawings is planned widening of the wharfs which was not carried out. In 1977 the harbor bottom between Berths S14 and S15 was again dredged to restore the shoaled areas to 35' depth (NAVFACPAC 1977, dwg 7016790). The 1977 dredging was carried up to a line about 100' from the edge of the boat landing at the head of the loch, the same line indicated as the limits of the 1959 dredging. Soundings were again taken in 1983 for another maintenance dredging of the harbor at the wharfs (NAVFACPAC 1983, dwg 7040718). By this date, shoaling was slight, reducing the 35' depth area between quay S14 and pier S15/S16 typically to about 32' to 34' in some sections. An area about 250' x 60' at the south end of S14 remained over 35' deep.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings:

Historic drawings are available as electronic scans only, were viewed on the Naval Facilities Engineering Command, Pacific (NAVFACPAC) Plan File data base at Facility No. 258, Makalapa, Pearl Harbor. Scans can be viewed and printed on 11" x 17" paper only. Drawings for these wharfs are indexed under building numbers S13 to S19.

B. Early Views:

Aerial photos are available at the National Archives and Records Administration, and the Admiral Furlong Collection at the Hawaii State Archives. The photos of the Admiral Furlong Collection were taken under the direction of Admiral William R. Furlong, Commandant of the Pearl Harbor Navy Yard. Photos in both archives were created by a U.S. federal agency (U.S. Navy) and are considered in the public domain. Photos of the submarine *F-4* are available at the Hawaii State Archives, box PP103, folder 10 and also at the Naval Historical Center Archives at the Washington Navy Yard. A photo showing the wharfs ca. 1945 is available in the Kidder Smith Collection at NAVFAC Archives, Port Hueneme, CA. Photos showing the replacement of timber fenders ca. 1957-59 are located in the archives of the Bishop Museum, Honolulu Hawaii in folder "Geography, Oahu, Pearl Harbor, Naval Base."

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U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
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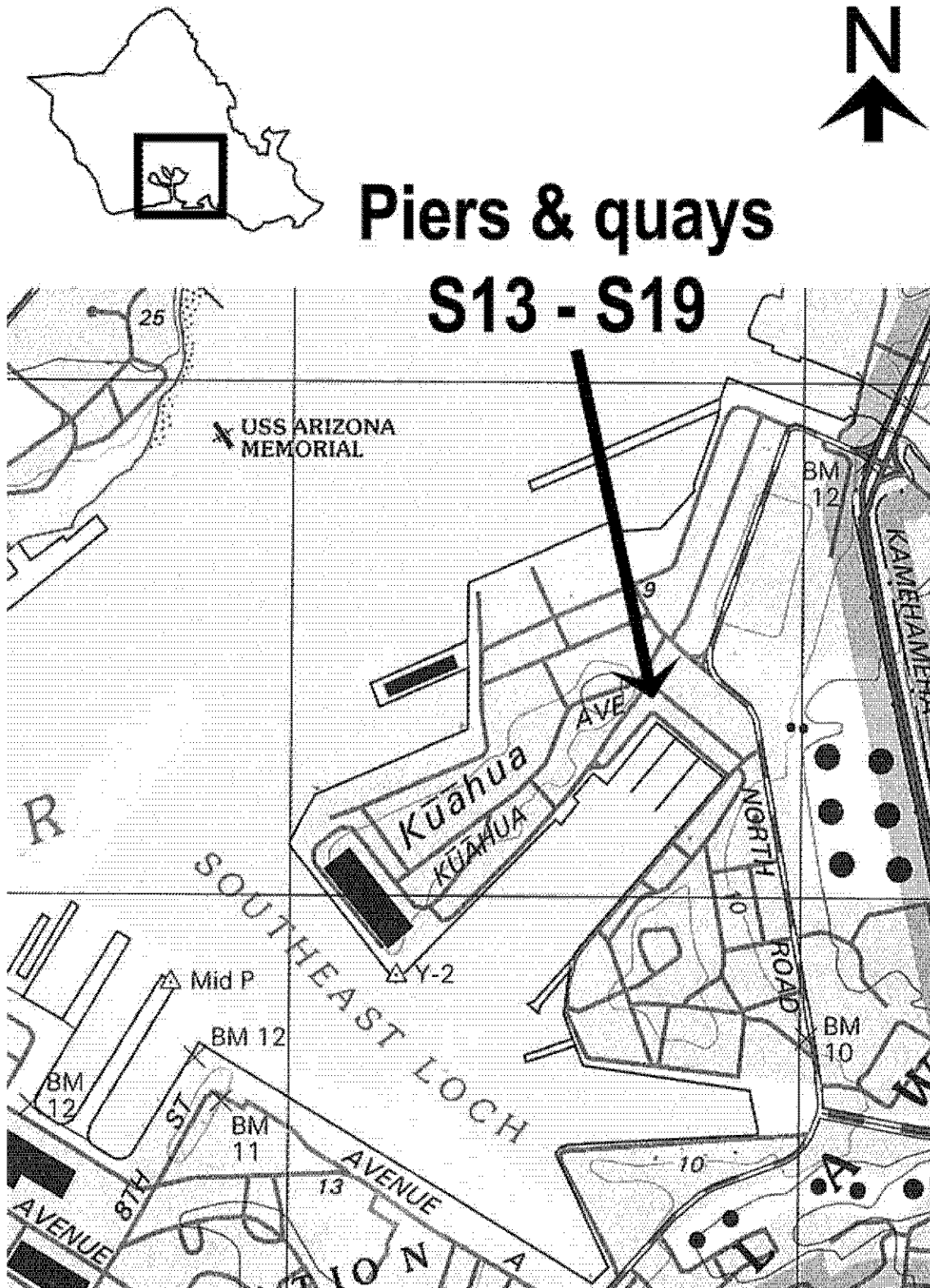
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PART IV. PROJECT INFORMATION

This documentation is being undertaken as mitigation for the construction related to repairs, maintenance, and improvements to Berths S13 to S20 in the Submarine Base area of the Pearl Harbor Naval Complex, within the boundaries of the Pearl Harbor National Historic Landmark. This report is to fulfill requirements stipulated by the March 2004 Programmatic Agreement between Commander, Navy Region Hawaii and the Hawaii State Historic Preservation Officer regarding waterfront maintenance and improvements.

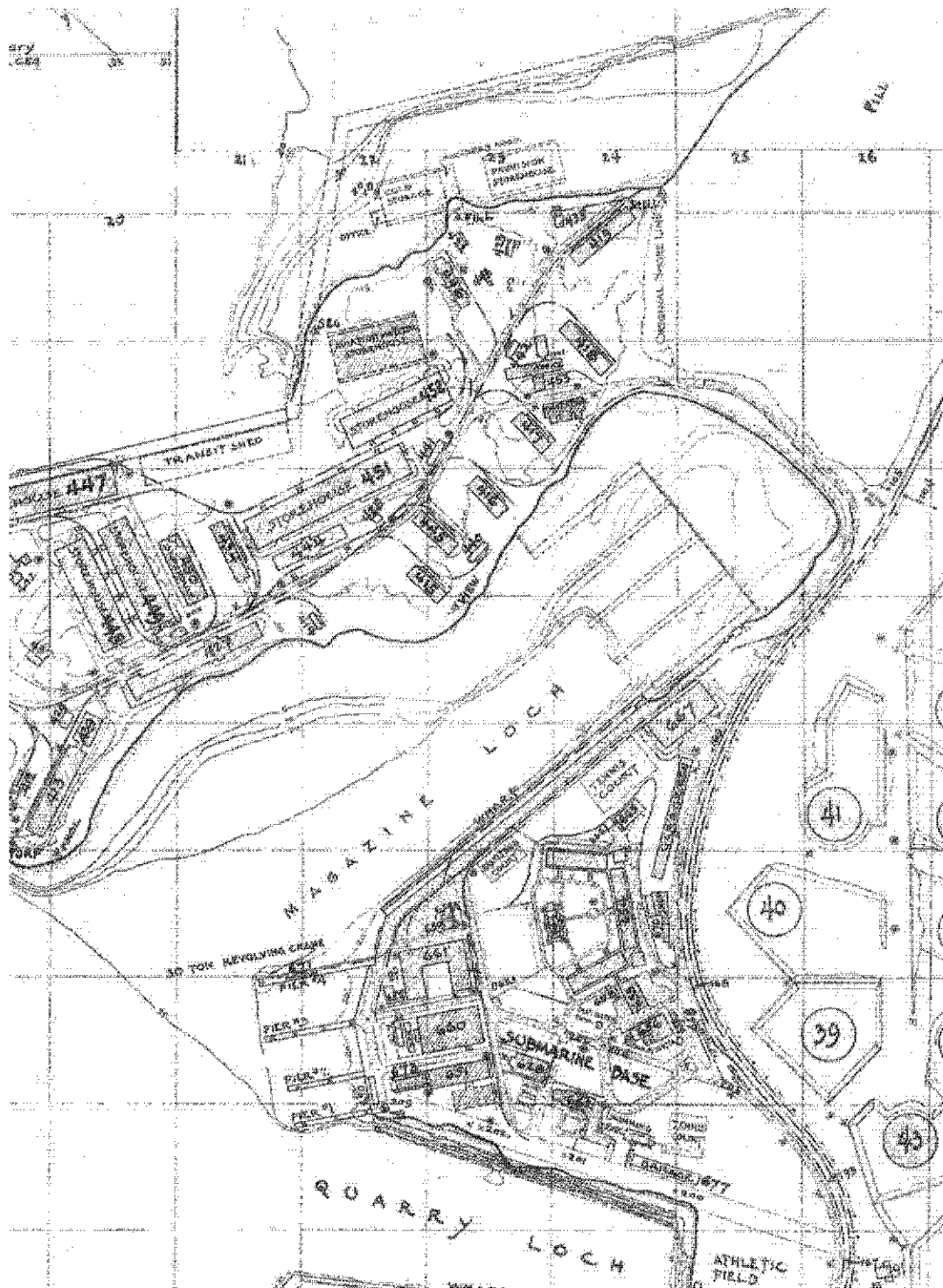
Location map.



U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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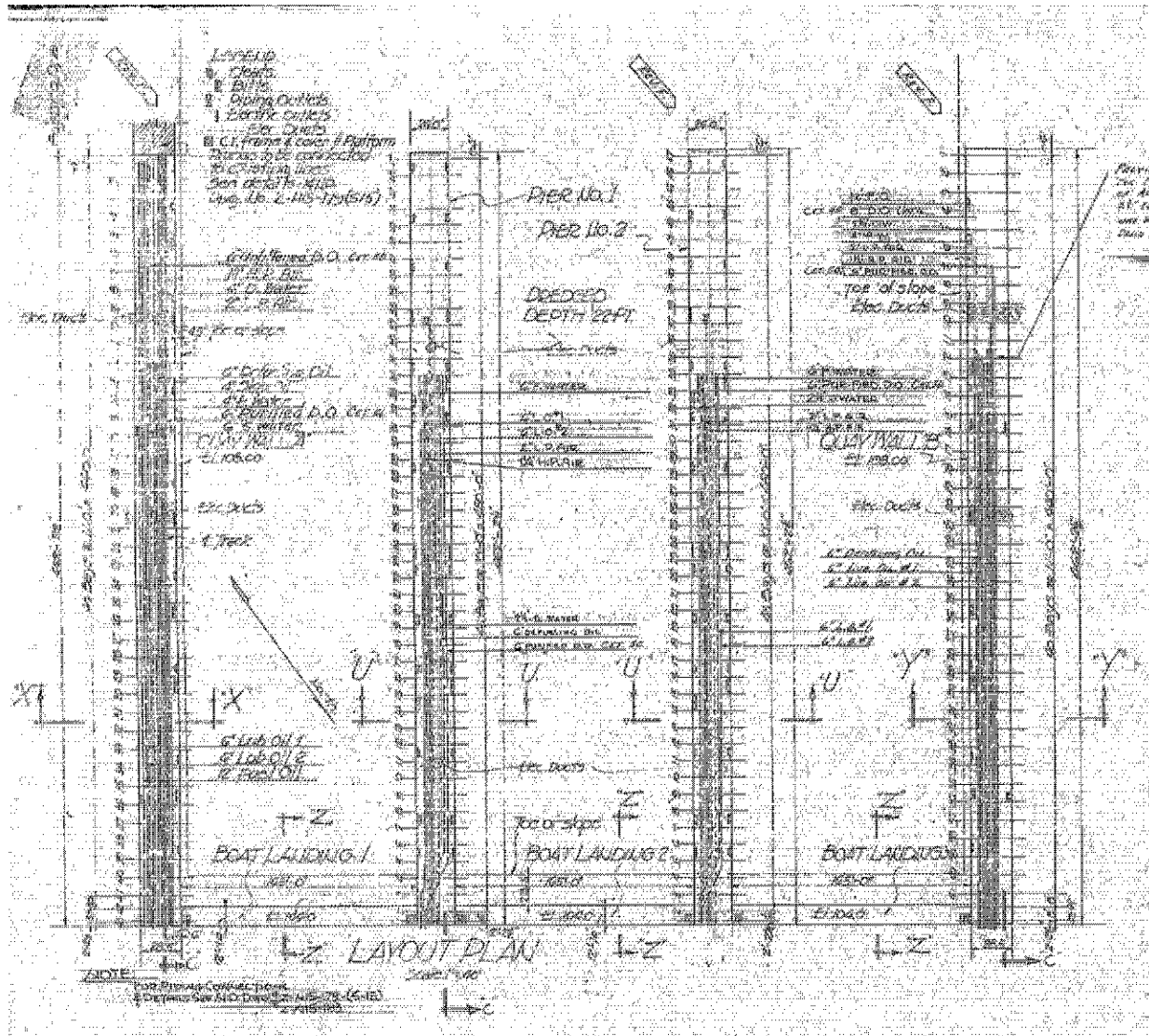
Portion of map dated June 30, 1941 showing the future locations of additional piers & quays, S13 to S19, at the head of Magazine Loch. North at top. Note the earlier isthmus connecting Kuahua to the mainland. The area northeast of the isthmus has already been filled.

NARA II, Cartographic section, RG 71 #1400-3-106.



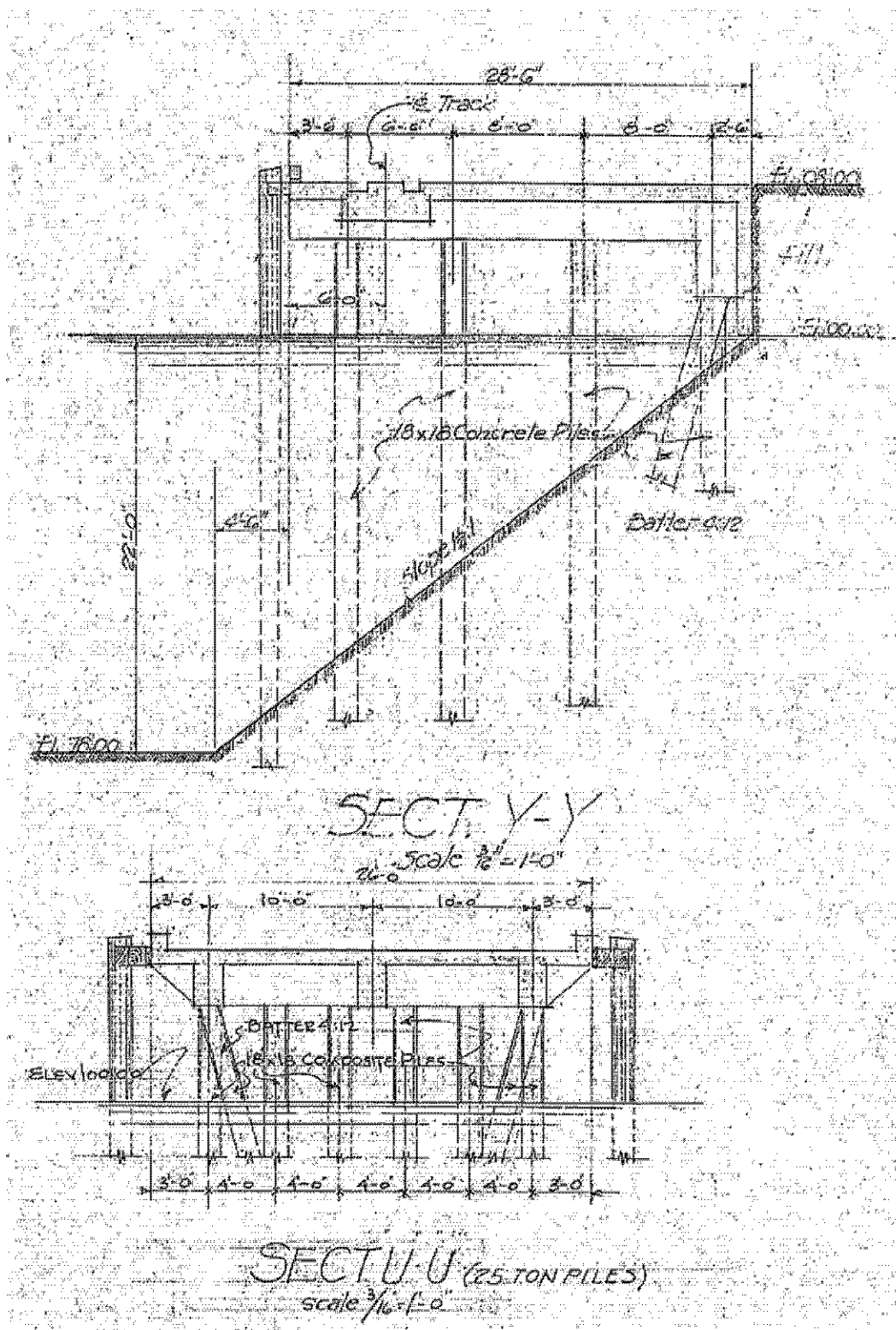
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
 (U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Portion of drawing dated January 14, 1942 showing the plan of the additional quays and piers, S13 to S19. NAVFACPAC dwg 179955.



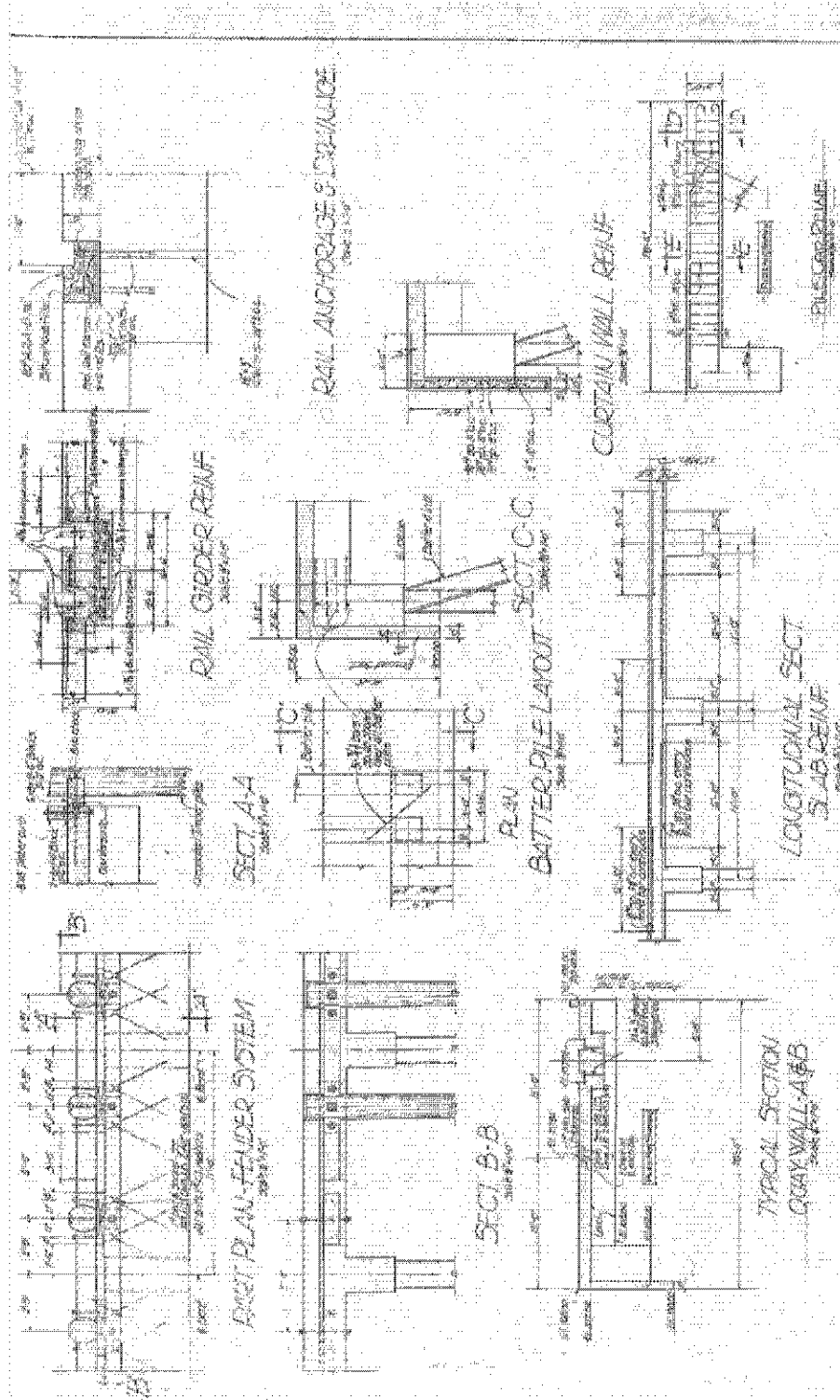
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
 (U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
 HAER No. HI-84 (Page 19)

Portion of drawing dated January 14, 1942 showing cross sections of the additional quays and piers, S13 to S19. NAVFACPAC dwg 179955.



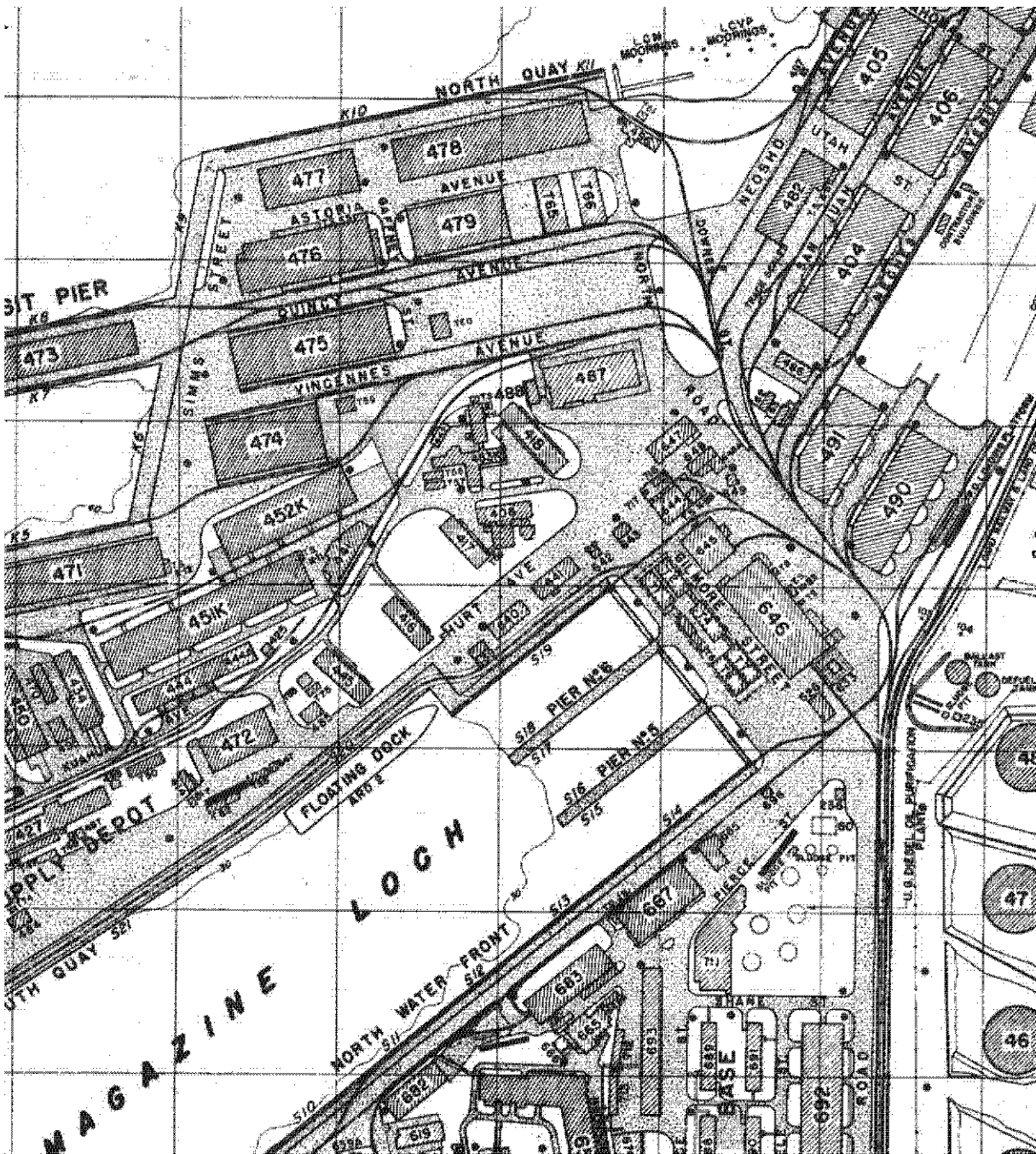
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
 (U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
 HAER No. HI-84 (Page 20)

Portion of drawing dated January 14, 1942 showing details of the piles, slab and fenders.
 NAVFACPAC drwg 179956.



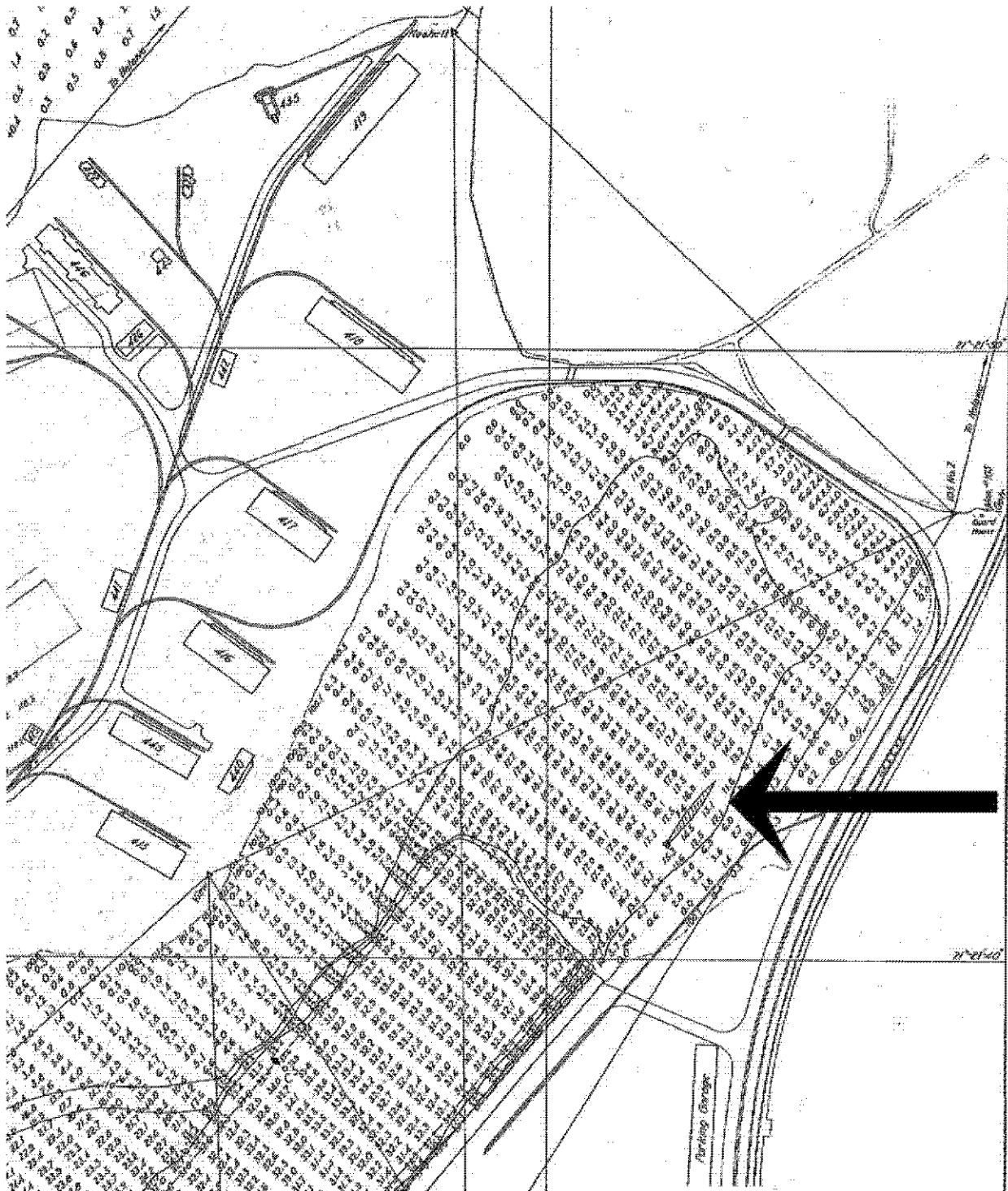
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
HAER No. HI-84 (Page 21)

Portion of map dated June 30, 1946 showing the additional piers & quays, S13 to S19, as well as the buildings of the Shop Facilities Complex northeast of those wharfs. North at top. NARA II, Cartographic section, RG 71 # 1400-3-145.



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NAVFACPAC dwg #B-N22-227.



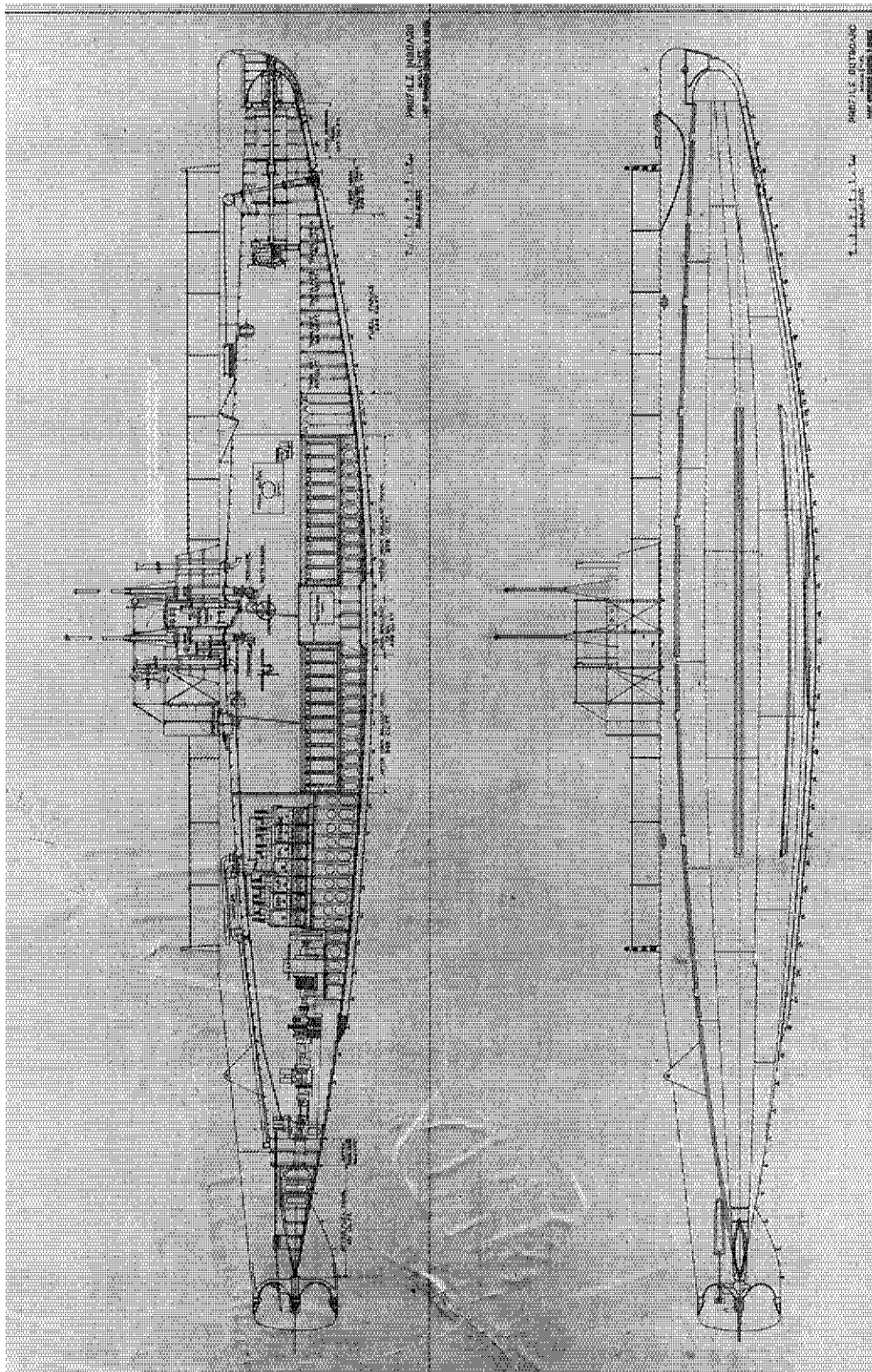
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Portion of historic photo dated October 12, 1923 showing Magazine Loch. North at top.
NARA II, Still Photo section, #71-CA-171B-10.



U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
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Drawing dated June 1910 showing profiles of the submarine F-4. Naval Historical Center Archives, Photo # NH 84383.



U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
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Portion of photo dated November 27, 1923 showing the remains of the submarine *F-4* (added white arrow) beached on the shore of Magazine Loch. View facing southeast. NARA II, Still Photo section, # 71-CA-157H-13.



U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Portion of a historic photo dated August 22, 1941 showing Magazine Loch and the fill northeast of the Kuahua isthmus. North at top. NARA II, Still Photo section # 80-G-182875.



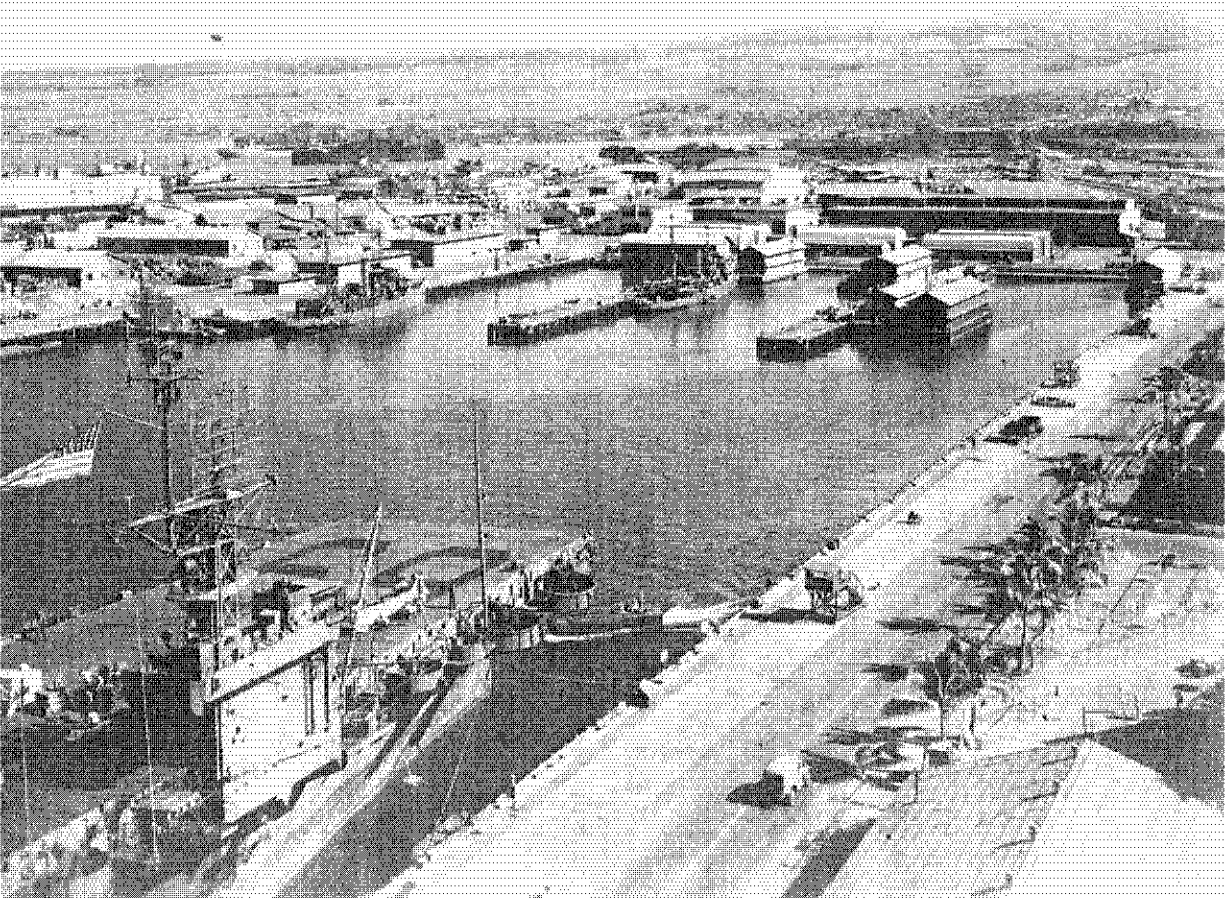
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Portion of a historic photo dated May 26, 1944 showing Magazine Loch and piers & quays S13 to S19. View facing west. Hawaii State Archives, Admiral Furlong Collection, PPFUR2-4, photo 64VF CASU-2.



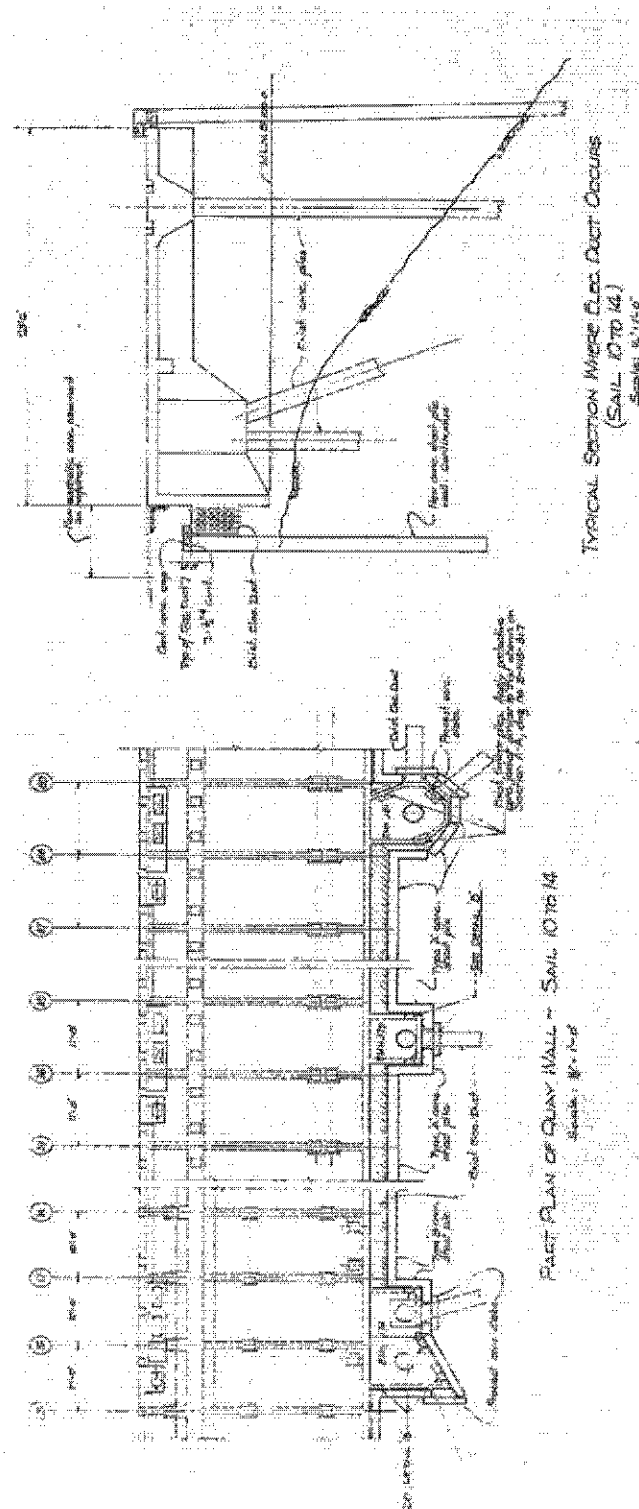
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
HAER No. HI-84 (Page 28)

Portion of a historic photo dated ca. 1945 showing the additional piers & quays, S13- S19. View facing north. Port Hueneme NAVFAC archives, Kidder-Smith collection, photo N-195-9.



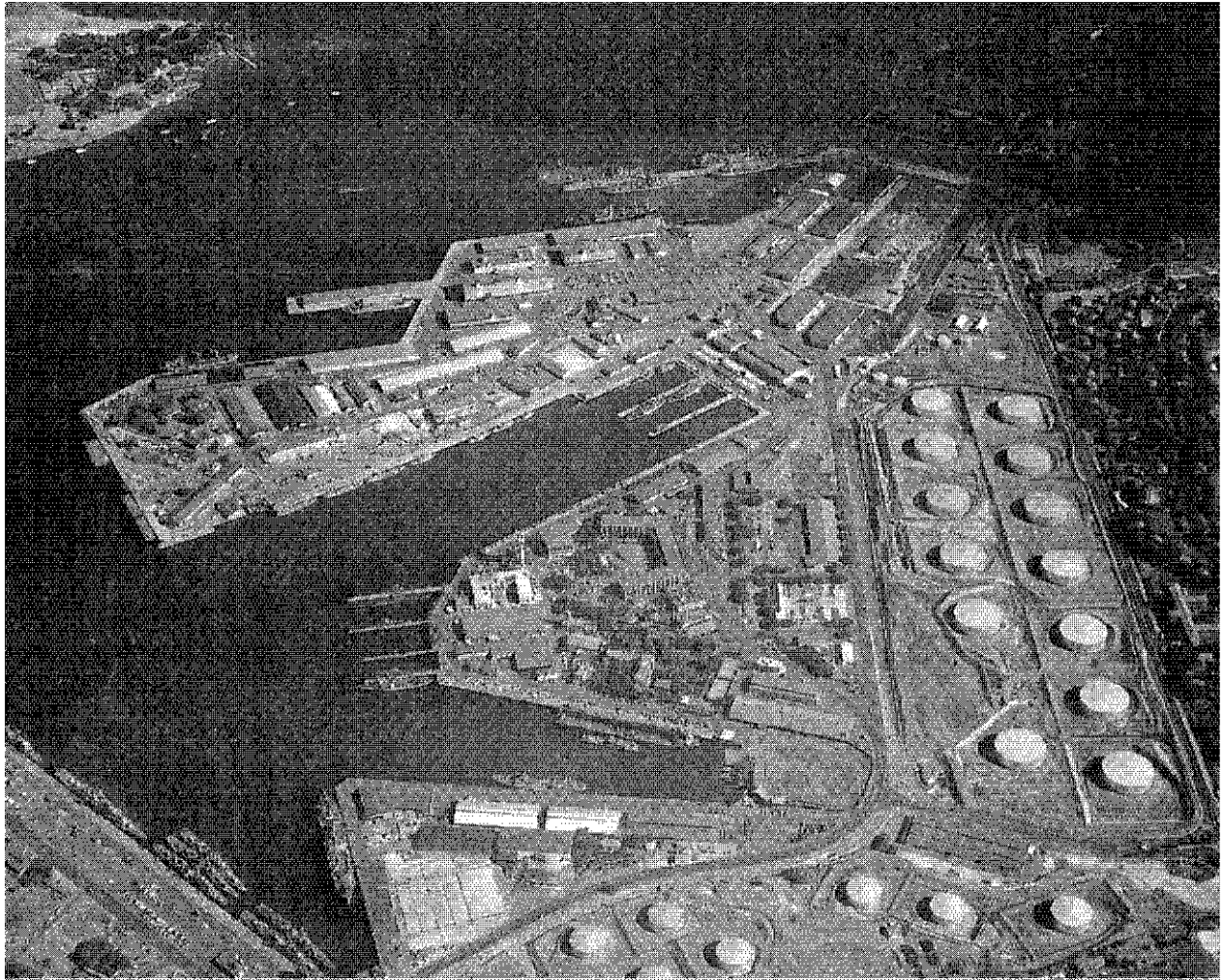
U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
HAER No. HI-84 (Page 29)

Portion of drawing dated January 5, 1952 for repairs to S-wharfs showing typical sections and plan of the quay wall with the electrical duct. NAVFACPAC drwg 551027.

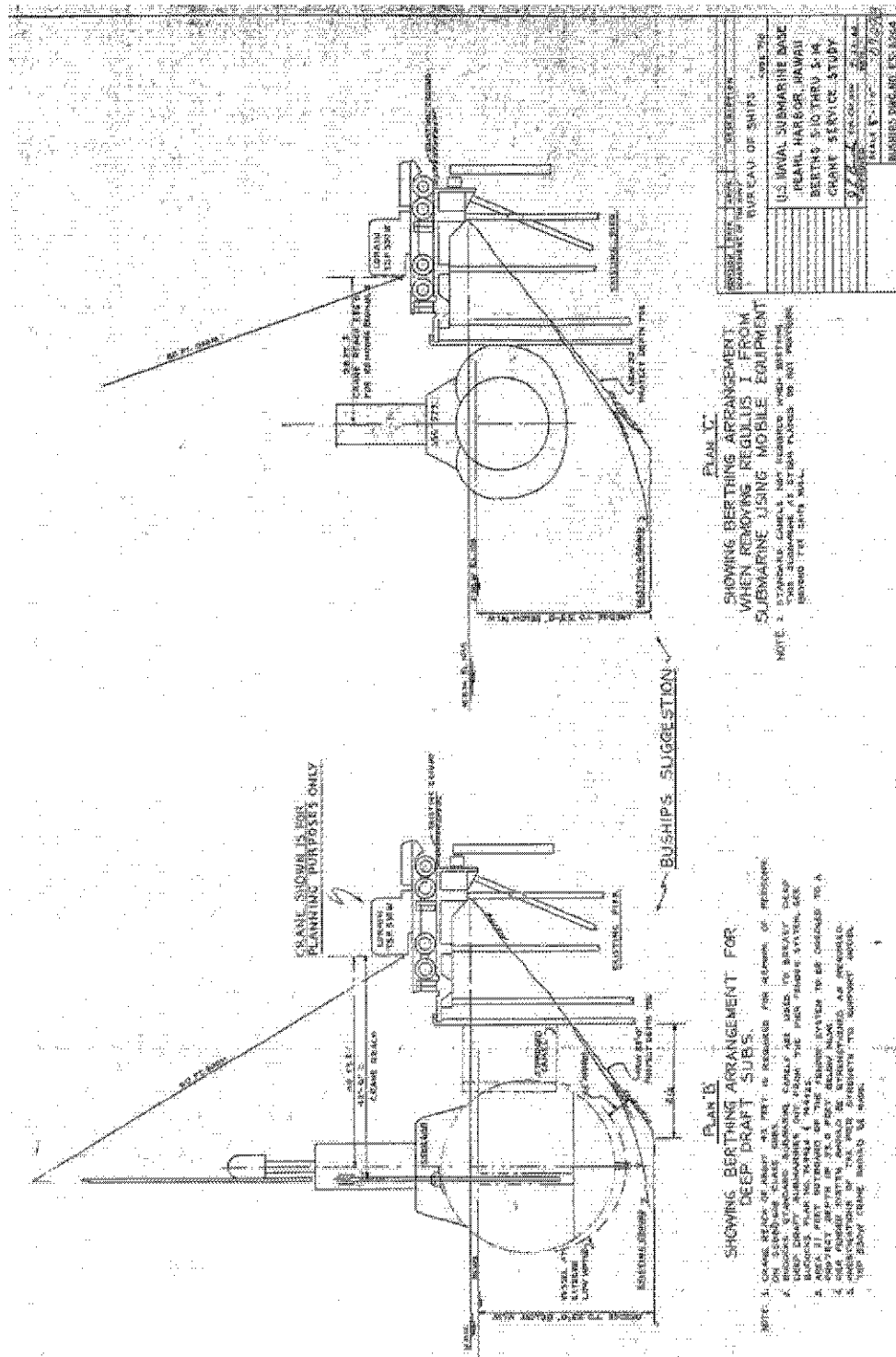


U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Portion of historic photo dated October 6, 1957 showing the piers & quays S13 – S19.
NARA II, Still Photo section #80-G-1036489.



Portion of drawing dated April 22, 1960 showing, on right, the crane set-up needed at S10-S14 to remove Regulus missiles from USS *Growler* (SSG 577). Also shown on left of drawing is the crane set-up needed to service the nuclear submarine USS *Ethan Allen* (SSBN 608). NAVFACPAC dwg 9293.



U.S. NAVAL BASE, PEARL HARBOR, ADDITIONAL PIERS AND QUAY WALLS, S13 TO S19
(U.S. Naval Base, Pearl Harbor, Sierra Wharfs S13 to S19)
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Map showing existing conditions at the Submarine Base, Pearl Harbor. Note the extant buildings of the Shop Facilities Compound, 640, 641, & 644 near S19. North at left.

